REMR TECHNICAL NOTE CO-SE-1.1

DIVER INSPECTION OF COASTAL STRUCTURES

PURPOSE: To describe an effective method for inspecting the underwater portions of coastal structures.

APPLICATION: This technical note discusses diver inspection of horizontal or nearly horizontal underwater structures. Often it is desirable to use divers to inspect coastal structures, either because reliable underwater imaging equipment is unavailable or simply to "truth" the results of underwater images. A typical inspection might be organized to determine how well a stone mat has been placed in front of a breakwater.

PERSONNEL AND EQUIPMENT REQUIRED: The inspection team includes a boat operator, a diving supervisor, a standby diver, and two working divers. If evidence is to be collected which may cause or be used in support of litigation, the divers should be knowledgeable of the type of structure being investigated. Ideally, the responsible engineer should participate in the dive. Equipment required to accomplish the inspection includes: a suitable diver support vessel, line, buoys, weights, dive gear, and positioning equipment. A communication system linking the divers to the boat is helpful but not essential.

APPROACH: Corps regulations require that a dive plan be filed with the Agency Diving Coordinator (ADC) before commencement of diving operations. Pertinent items of the plan include: scope of the mission; type of support vessel; names of the working divers, supervisor and standby; anticipated surface conditions and underwater environment; and nearest hospital and recompression facilities. The dive plan must also include anticipated hazards. These include high waves, high currents, low visibility, low water or air temperature, and sharp or potentially diver entangling objects. The plan should detail the threshold at which diving activities will be terminated. This plan must be signed by the submitting diver, the branch chief and the ADC. Any changes in the plan must be approved by the ADC.

The inspection team chooses transects to explore questionable areas. It is important that the team accurately determine the location of these areas. This may be done electronically (i.e., using a LORAN or MINI-RANGER) or manually (i.e., using a sextant). The team builds an underwater transect line by attaching an appropriately long graduated line (usually 100-ft-long by 3/8-in.-thick double-braided nylon rope) between the weights (approximately 100 lb) attached to two approximately 1-ft inflatable buoys. They place one buoy and weight at one end of the transect, then feed out the connecting line as the vessel proceeds to the other end of the transect, at which point they release the second buoy (Figure 1).

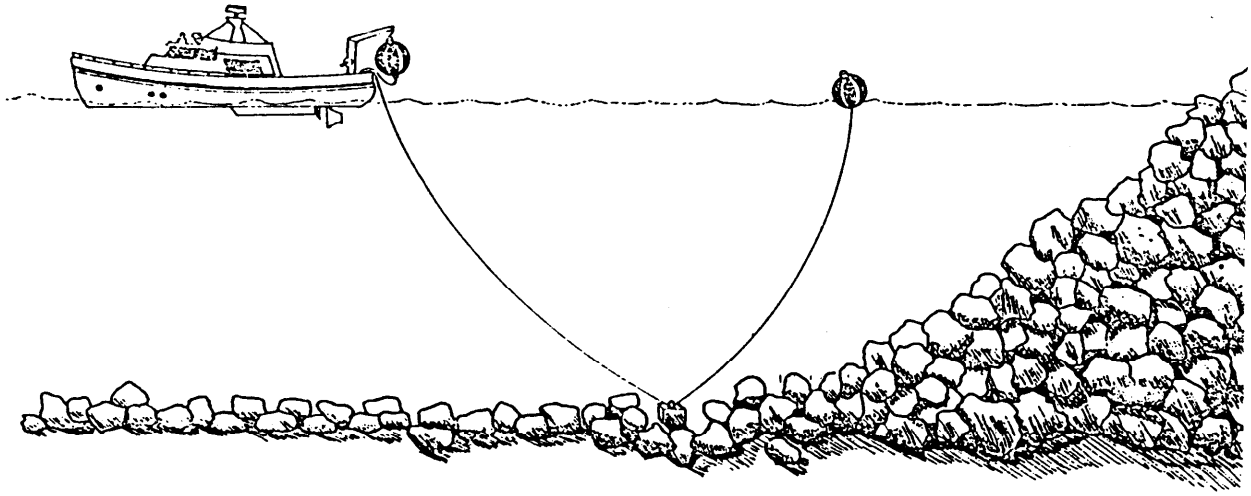

Figure 1. Buoy placement

After the graduated transect line is in place, the two working divers proceed down one of the buoy lines. At the bottom, the divers stabilize their buoyancy and inspect the area around the buoy weight. If visibility is good, the divers usually inspect the area as they proceed together along the underwater stationed off transect line (Figure 2). In most cases, however, visibility is poor, ranging from 3 ft to total darkness. Under these conditions, the divers place themselves on opposite sides of the line, link their inside hands together over

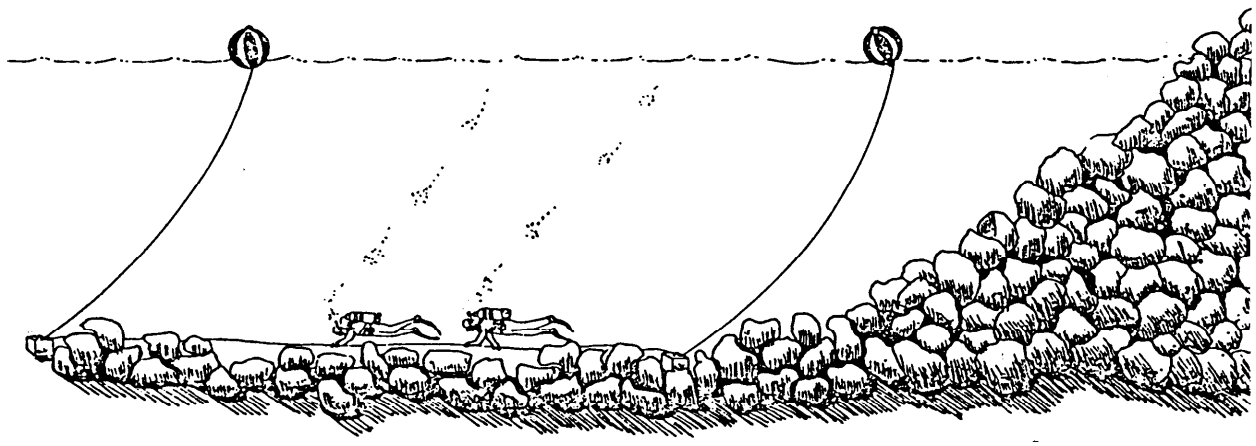

Figure 2. Diver inspection

rope, and slowly swim the line while tactiley exploring the area with their free outside hands and legs. The divers note percent stone cover, location of uncovered areas, size of the rock placed, broken units, location and size of underwater ridges and holes as well as other features of interest. Locations of important underwater features may be marked by lightweight floats. These can be sighted on by the support vessel for determination of their distance along the transect. Upon arrival at the opposite end of the transect, the divers proceed slowly up that buoy line and are picked up by the support vessel. The divers quickly dictate their report to one of the support crew, trying to tie features of the seascape to distance along the transect. If desired, the divers may repeat the dive to confirm their interpretations. The inspection team may also choose to use a diver-to-surface communication system to allow the divers to describe underwater features directly to the support vessel.

APPLICATION: Investigators can use the inspection team's findings to confirm the accuracy of available underwater images or, in their absence, begin to map out the underwater features of the structure. Other transects may have to be studied to produce a complete picture of the area. Similar diver surveys could be used to investigate riprap, sea grass plantings, artificial reefs, and other artificial or natural underwater features.

REFERENCES:

a. Side scan sonar for inspecting coastal structures. J. Clausner. In: Coastal Engineering Notebook, US Army Engineer Waterways Experiment Station, Vicksburg, MS, Nov 1983. Coastal Engineering Technical Note III-16.

b. Inspection of submerged arctic structures by side scan sonar. D. P. Patterson, A. T. Shak, and M. T. Czernaik. 14th Annual Offshore Technology Conference, May 1982. OTC Paper 4224.